

REMARKS AND ELECTION

Applicant hereby elects, with traverse, Group IV, claims 6 (in part), 13 (in part), 33 (in part), 7, 14, 26, 27 and 34, drawn to a tomato variety having double lycopene content, wherein the variety is HA3518.

Applicant respectfully traverses the restriction requirement applied to Groups I-IV and asserts that Group I (drawn to tomato variety HA3512), Group II (drawn to tomato variety HA3513) and Group III (drawn to tomato variety HA3519) are related to elected Group IV, and, therefore, these Groups should not be deemed to constitute different inventive concepts, but, rather to form a single general inventive concept.

Furthermore, Applicant expressly reserves the right to rejoin the currently non-elected claims upon the Examiner's finding that Groups I-IV are linked by a special technical feature so as to form a single general inventive concept, and allowance of the linking claims.

The Restriction Requirement states that the technical feature linking Groups I-IV is a tomato with a *dg* mutation and double lycopene content. The Restriction Requirement contends that the cited reference (Levin et al. (2003)) teaches *dg* mutants with double lycopene (Table 1 on page 457) and, therefore, the technical feature linking the inventions of Groups I-IV is considered as not defining a contribution over the prior art.

Applicant, however, respectfully submits that the present invention makes a patentably distinct contribution over the disclosure of Levin et al. (2003).

Levin et al. (2003) teaches the allelic polymorphism characterization of the tomato *dark-green* (*dg*) and *high pigment* (*hp*) mutations. This publication provides the molecular marker for the *dg* mutation. During the screening process, F2 plants homozygous for the *dg* mutation and containing high lycopene content were characterized (Table 1, p. 457). However, these homozygous *dg* mutant plants comprise the pleiotropic, undesired traits well-known to be linked to the *dg* mutation, as stated in Levin et al (2003), p. 459:

"The similarities in the pleiotropic phenotypes between the *dg* mutation and several of the known *hp* mutations were recognized by Mochizuki and Kamimura (1984), but the molecular link was missing prior to our research."

Therefore it can be concluded that these F2 plants are **not suitable** for the production of robust, commercial tomato strains due to their pleiotropic and deleterious traits, which include undesirable agronomical traits that are linked to the *dg* mutation (i.e. see Sacks E.K. and Francis, D.M. 2001. J. Amer. Hort. Sci. 126(2):221-226).

On the other hand, the present application provides **robust, commercial tomato cultivars**, homozygous for the *dg* mutation, producing fruit comprising high lycopene content, **while devoid of undesirable traits linked to the *dg* mutation**. This combination of traits characterizing the tomato varieties of the present invention is claimed in claim 1:

*"A **robust** tomato variety homozygous for the *dg* mutation, wherein tomatoes grown from this variety have an average lycopene content at least two fold its average content in currently available varieties, **while being devoid of deleterious traits** associated with the *dg* mutation, when measured at peak lycopene content."*

The specific pleiotropic traits which are **absent** in the tomato varieties of the present invention are detailed in claim 5:

*"The variety of any one of claims 1-3 which is **devoid of dg-linked deleterious traits** selected from the group consisting of poor germination rate, shallow root system, brittle stems, thin and/or fragile leaves, premature defoliation, low yield, and small fruit."*

The fact that the tomato varieties of the present invention are **devoid of the pleiotropic undesired traits linked to the *dg* mutation** is disclosed, demonstrated and emphasized several times in specification of the application as cited below:

*"Within the scope of the present invention the term hybrid varieties encompasses any **robust** hybrid variety that is homozygous for the *dg* mutation **devoid of the traits poor germination rate, shallow root system, brittle stems, thin and/or fragile leaves, premature defoliation, low yield and small fruit**."*

Page 2 para [0018]

"According to another embodiment, the hybrid varieties of the present invention are devoid of the deleterious traits associated with the dg mutation, including, inter alia, poor germination rate; shallow root system; brittle stems; thin and/or fragile leaves; premature defoliation; low yield; small fruit."

Page 2 para [0025]

"According to one embodiment, the present invention provides tomato seeds homozygous for the dg mutation, wherein the plants grown from the seeds yield fruit crops comprising an average lycopene content at least two fold its content in currently available crop yields, while devoid of deleterious traits associated with the dg mutation. The deleterious traits include, inter alia, poor germination rate; shallow root system; brittle stems; thin and/or fragile leaves; premature defoliation; low yield; small fruit."

Page 4 para [0053]

"Eight hybrids were found to contain high lycopene content (over 200 ppm), and normal growth pattern. The parent lines of these 8 selected hybrids were self pollinated and planted for sufficient number of generations to obtain stabilized parent plant, homozygous for the dg mutation while devoid of: poor germination rate; shallow root system; brittle stems; thin and/or fragile leaves; small fruit; low crop yield."

Page 6, Example 1, para [0089]

The present application further discloses the specific **screening and selection** steps that were carried out in order to achieve the tomato varieties as claimed in the present application, having the specific combination of homozygous *dg*, high lycopene and devoid of any pleiotropic effects. These steps and characteristics of the selected tomato plants are specified in the

DETAILED DESCRIPTION section of the application, p. 4, para [0057] to para [0071], as briefly outlined below:

"Step 3: The expected dg/dg seedlings were taken for further growth in a greenhouse during the winter.... Lateral shoots were pruned during the growth period to enhance the pleiotropic effects (including brittle stems, fragile leaves, shallow root system, small fruits and low crop yield). Plants were left for self-pollination and seeds (F3) were collected from plants showing minimal pleiotropic effects...

Step 5: Further selection was performed by the following sequential steps: a) Each breeding line was examined for average performance, including: lycopene content, volume of root system, vigor, fruit size and fruit yield, leaf appearance and health and total soluble solid content (TSS/BRIX)...

The seedlings selected after step 5 (c) were dg homozygous, and therefore produced fruits comprising high lycopene content, while showing low dg-linked deleterious effects.

To obtain superior commercial varieties, these F4 plants were again crossed with a mixture of commercially valuable breeding material as described above, and steps 1 to 5 were repeated. Best performing plants (tentative parent varieties) were selected and crossed to obtain experimental F1 hybrids. The experimental F1 hybrids were examined...according to the following parameters:

Lycopene content, measured spectrophotometrically as described herein below;

Fruit crop yield measured as tons/1000m²;

Fruit quality, scored according to the following: firmness, shape, texture (including fibrous and puffiness) and taste;

Soluble solid content (Brix), measured as described herein below;

***Plant quality**, scored according to the followings: vigor, plant resistance to various diseases, plant resistant to stress, foliage health and density, unity of ripening and fruit quality at ripening. Best performing F1 plants (i.e. plants producing fruits comprising at least 200 ppm lycopene **without showing any pleiotropic effects**) were identified."*

As demonstrated in Examples 1 and 2 of the specification, the achieved tomato varieties have the combination of high lycopene content **and** commercially valuable traits as high fruit yield and fruit quality, which are **the consequence of the absence of pleiotropic affects**:

*"This large-scale trial represents various growth conditions, including local whether [sic] hazards and sub-optimal growth regime. Nevertheless, **the average yield obtained from entire plot examined was commercially acceptable**, and the average lycopene content of 235 ppm is significantly high.*

*Fig. 1 shows comparison of fruit yield of various commercial varieties and hybrid HA3518 obtained at one location (Akko, North Israel). **The average crop yield of hybrid HA3518 was 10.8Kg/m2, which is considered as average to high yield for a commercial variety.**"*

Example 1, p. 6 para [0090]

*"Table 2 above clearly shows that the new high lycopene hybrids of the present invention are **superior over the common commercial varieties examined, as they produce fruits with total soluble solids and lycopene content significantly higher compared to the commercial varieties.** The lycopene content according to this example is 2.5 fold higher."*

Example 2, p. 7 para [0092]

In sharp contrast to this, the tomato *dg* homozygous mutants of Levin et al (2003) retain the pleiotropic traits linked to the *dg* mutation. These mutants were **not** screened for **any** of the

above parameters or selected for plants that are devoid of **any** of the deleterious traits associated with the *dg* mutation. Thus linkage between the *dg* mutation and the *dg*-linked deleterious traits was not broken.

To summarize, the **robust and commercial** tomato lines of the present invention are distinct from and **significantly superior** over the tomato plants of Levin et al, which are pleiotropic, not robust and have undesirable agronomical traits that prevent their use as commercial strains for the fresh market. This argument is clearly presented in the present application, p. 3, para [0049]:

*"The present invention provides tomato varieties which are homozygous for the dark green (dg) mutation. As described herein above, tomato plants carrying the dg mutation are characterized by their dark-green fruits, which, upon ripening, become dark red, due to a high lycopene content. **Tomato plants carrying the dg mutation, and even plants homozygous for the dg mutation were described before; however, the pleiotropic affects of the [sic] this mutation, which include undesirable agronomical traits, prevented the use of the high pigment dg gene in breeding programs.** The present invention now discloses novel, hardy hybrid tomato varieties which are dg homozygous, comprising a very high lycopene content **while being devoid of the undesired pleiotropic effects associated with the dg mutation.**"*

To further support the claims of the present application and their novelty and inventiveness over the cited publication, the Applicant hereby provides experimental data showing that Levin's *dg* homozygous tomato mutants are pleiotropic, while the tomato variants of the present application are devoid of the pleiotropic traits. These experiments, carried out on 2002, compare LRT915 of Levin et al (p. 457 Table 1) with the elected variety HA3518 of the present invention (see Declaration under 37 CFR 1.132 of Peleg Ezri). The comparison between the tomato varieties was performed in several distinct locations in Israel. These results conclusively show that the elected strain of the present application HA3518, which is an example of the tomato varieties claimed in claim 1, is superior in **higher yield, higher lycopene** and in

other important agronomical traits such as **germination rate**, **strong root system**, **strong foliage** and **fruit quality** relative to the cited strain of Levin (LRT915). As stated in the Declaration under 37 CFR 1.132 of Peleg Ezri, such beneficial traits are a consequence of the absence of pleiotropic effects linked to the *dg* mutation in these variants. Thus, the additional experimental data submitted in response to the Restriction Requirement clearly demonstrates that the *dg* tomato mutants of Levin retain the pleiotropic traits, whereas the tomato variants of the present application are devoid of these traits (and therefore comprise robust varieties comprising valuable commercial traits).

In view of the above, it is respectfully submitted that the special technical feature linking Groups I-IV defines a contribution over the prior art (Levin et al.) and therefore relates to a single general inventive concept. Therefore, it is requested that the non-elected Groups I-III should be rejoined with the elected Group IV.

Further to the above, Applicant expressly reserves the right to file one or more divisional or continuing applications to protect the invention of the non-elected Groups, and other disclosed but unclaimed subject matter prior to issuance of this application.

Respectfully submitted,

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Date

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